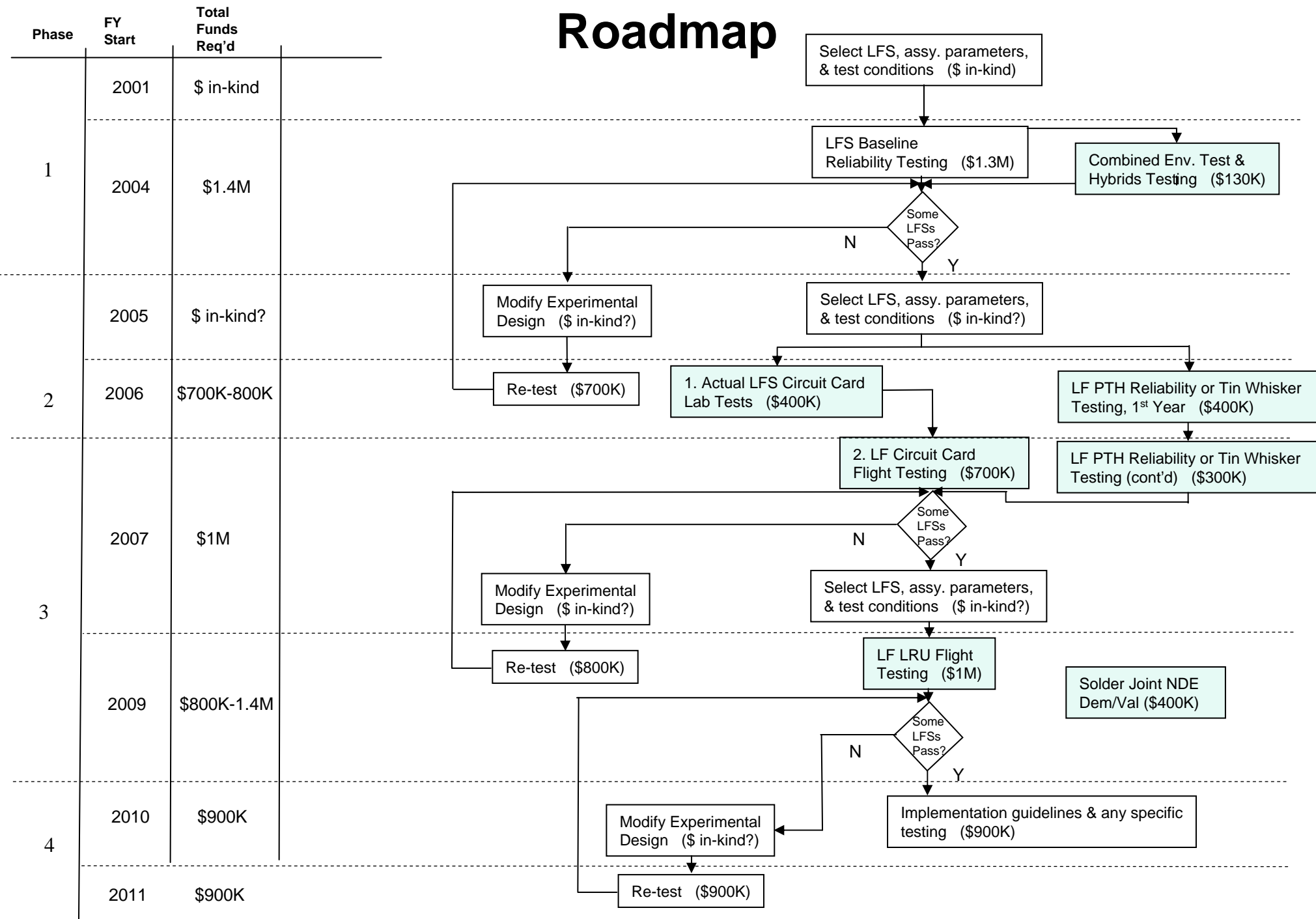
The background of the slide is a faded, high-angle photograph of a complex electronic circuit board. The board is populated with numerous integrated circuits, resistors, and other electronic components, all interconnected by a dense network of fine traces. The overall color palette of the background image is muted, with various shades of grey, blue, and yellow.

Path to Lead-Free Solder Implementation

September 2004

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Proposed DoD-NASA Pb-free Solder Implementation Roadmap



Project Ideas

FY2004-start projects

1. JCAA/JG-PP lead-free solder project additional component testing

FY2005-start projects

2. Field testing of circuit card with lead-free solder
3. Tin whisker mitigation
4. Reliability testing of un-filled plated-through-holes with a high aspect ratio

FY2008-start projects

5. Field testing of line-replaceable units (LRUs) with lead-free solder
6. Dem/val non-destructive evaluation of solder joint and circuit card integrity

1. Additional Component Testing (Hybrids & CSPs)

Issue:

Current JCAA/JG-PP project test boards do not include some important component types, namely hybrids and chip scale packages (CSPs)

Project Objective:

Perform high-reliability (Class 3) testing of components excluded from the current JCAA/JG-PP project.

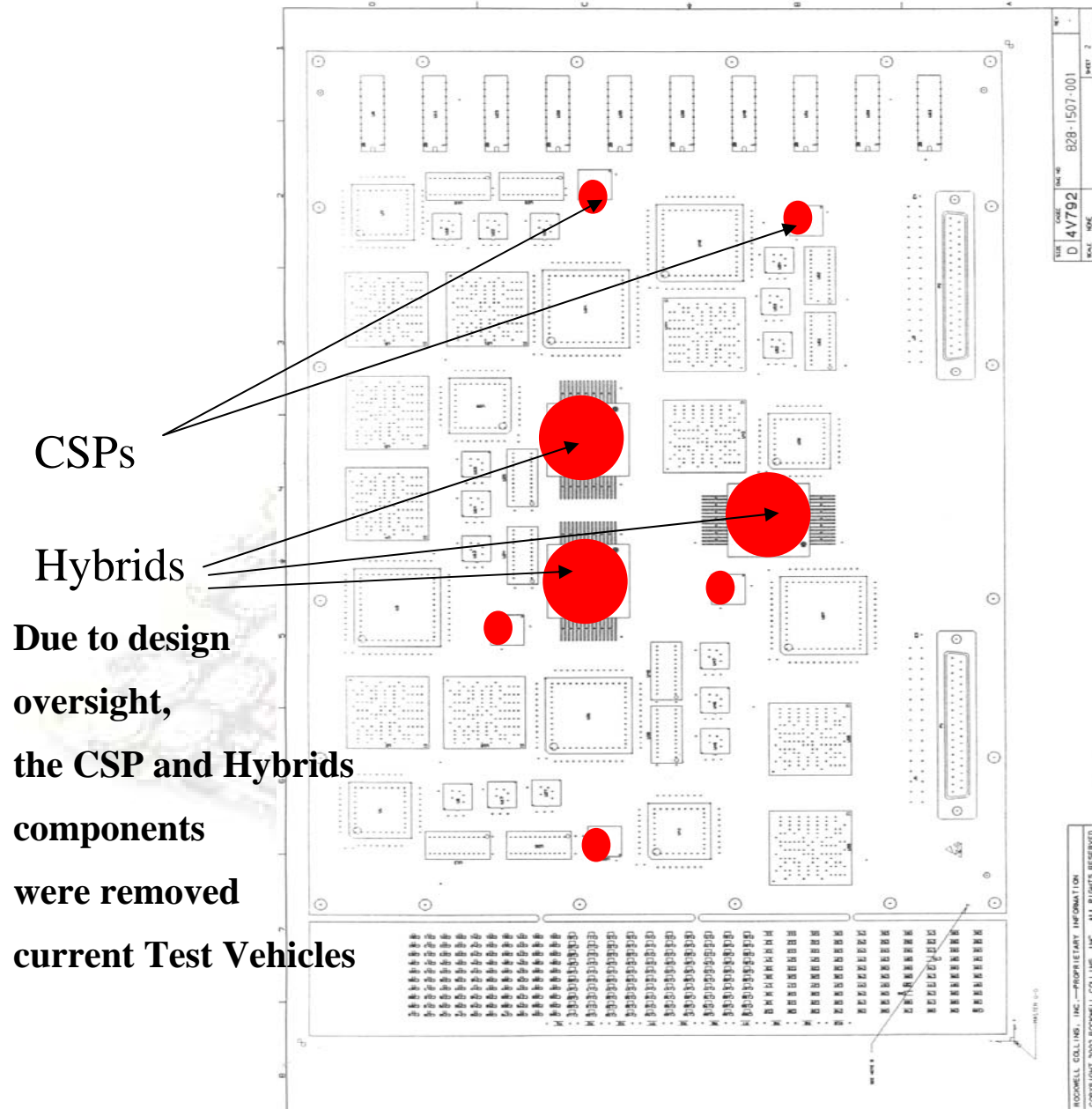
Approach:

Build ~30 custom (newly manufactured) circuit boards with same Pb and Pb-free solders from current project (and using the hybrids and CSPs already purchased by NASA). Perform thermal cycling & vibration tests IAW JCAA/JG-PP Joint Test Protocol.

Potential Stakeholders:

Same as JCAA/JG-PP LFS project (U.S. military services, NASA, military and commercial OEMs, gov't laboratories)

Lead-Free Printed Wiring Assembly



CSPs

Hybrids

Due to design oversight, the CSP and Hybrids components were removed current Test Vehicles

PWB

- 14.5"X 9"X 0.09"
- Immersion Silver Finish
- SnPb HASL (rework)
- 6 layers

PWA

- Surface mount and through hole components
- Total Quantity: 205 (119/86)

Lead-Free Solder Alloys

- Sn3.9Ag0.6Cu
- Sn3.4Ag1.0Cu3.3Bi
- Sn0.7Cu (stabilized)

Test Vehicle Design Layout from Draft Joint Test Protocol J-01-EM-026-P1

1. Additional Component Testing (Hybrids & CSPs)

Proposed Milestones & Funding:

FY2005 (\$38K)

- Project Start: Oct 2004
- Design Test Board: Oct 2004 – Nov 2004
- Purchase Boards: Nov 2004
- Build Boards: Dec 2004 – Jan 2005

FY2006 (\$140K)

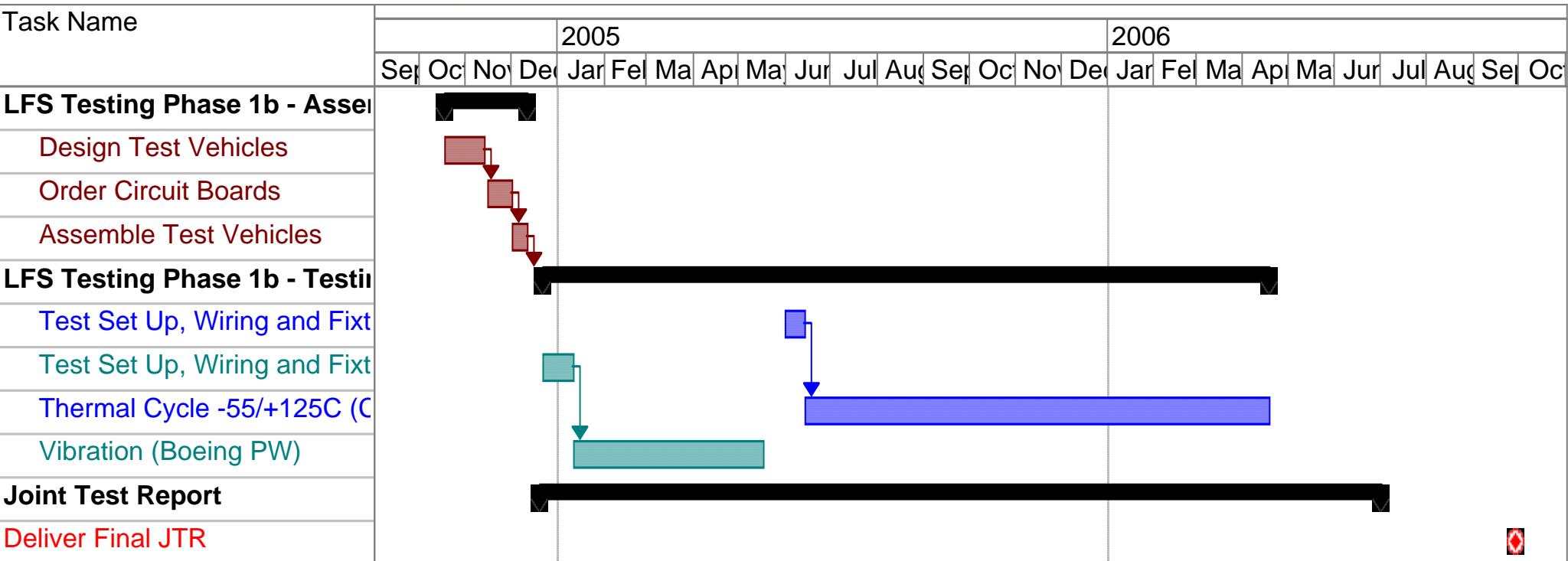
- Conduct Testing: Jan 2005 – Apr 2006

FY2007 (\$in kind)

- Complete Test Report: Oct 2006

1. Additional Component Testing (Hybrids & CSPs)

Schedule



2. Field Test Circuit Cards

Issue:

No known flight test data available for JCAA/JG-PP lead-free solders

Project Objective:

Field test the most promising lead-free solders from the current JCAA/JG-PP reliability testing

Approach:

Identify critical end-design board(s) on an existing system (e.g., F-15 radar) (those most subject to failure). Build 6-10 boards with the alternative solders. Flight test those boards for 18-months.

Potential Stakeholders:

U.S. military services, NASA, F-15 program, military and commercial OEMs, FAA, gov't laboratories

2. Field Test Circuit Cards

Proposed Milestones & Funding:

FY2005 (\$in-kind)

- Project Start: Dec 2004
- ID Stakeholders: Dec 2004 - Apr 2005
- Prepare Test Plan & Bill of Materials: Feb - Sep 2005

FY2006 (\$400K)

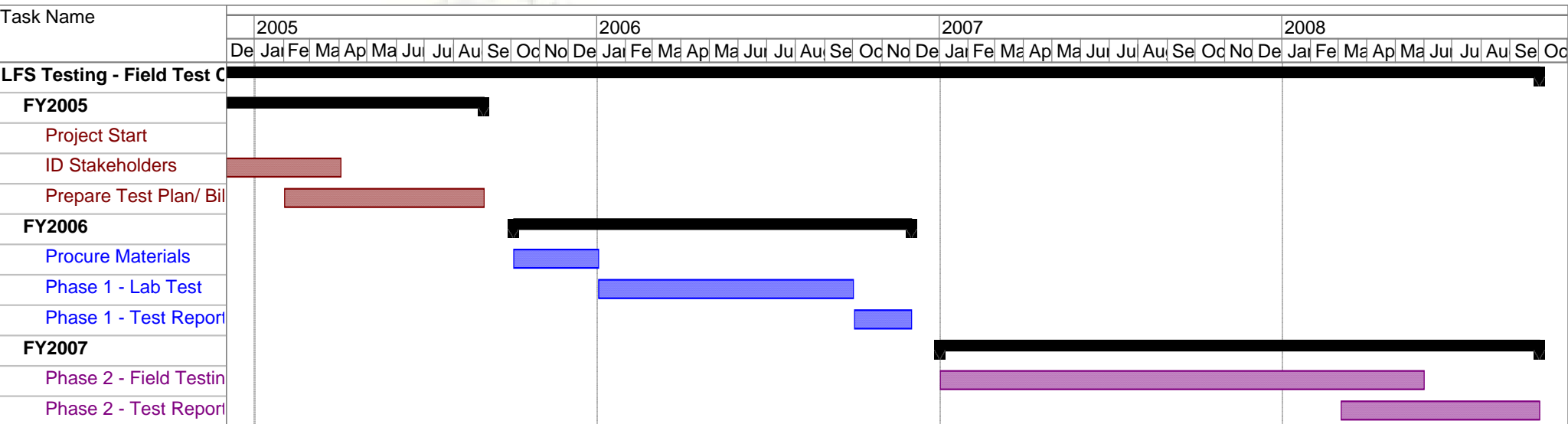
- Procure Materials: Oct – Dec 2005
- Phase 1 – Lab Testing: Jan - Sep 2006 (9 months)
- Phase 1 Test Report: Oct – Dec 2006

FY2007 (\$900K)

- Phase 2 – Field Testing: Jan 2007 - Jun 2008 (18 months, with intermittent check-ups)
- Phase 2 Test Report: Mar - Sep 2008

2. Field Test Circuit Cards

Schedule



3. Tin Whisker Mitigation

Issue:

Risk of tin whiskering (and resulting electrical shorts in systems) set to increase as suppliers switch to pure tin plating. Project would build off work being done by NEMI and NASA GSFC.

Project Objective:

Determine whether simple mitigation methods will stop whisker growth.

Approach:

Specifically design test coupons to grow tin whiskers rapidly (e.g., bright tin plating on brass). Apply materials (e.g., conformal coatings) over the tin plating, and expose to environmental conditions known to grow whiskers. Observe the coupons over the course of several years to determine if any of the coatings prevent/contain whisker growth.

Potential Stakeholders:

U.S. military services, NASA, military and commercial OEMs, FAA, gov't laboratories

3. Tin Whisker Mitigation

Proposed Milestones & Funding:

FY2005 (\$in-kind)

- Project Start: Dec 2004
- ID Stakeholders: Dec 2004 - Apr 2005
- Prepare Test Plan & Bill of Materials: Feb - Sep 2005

FY2006 (\$400K)

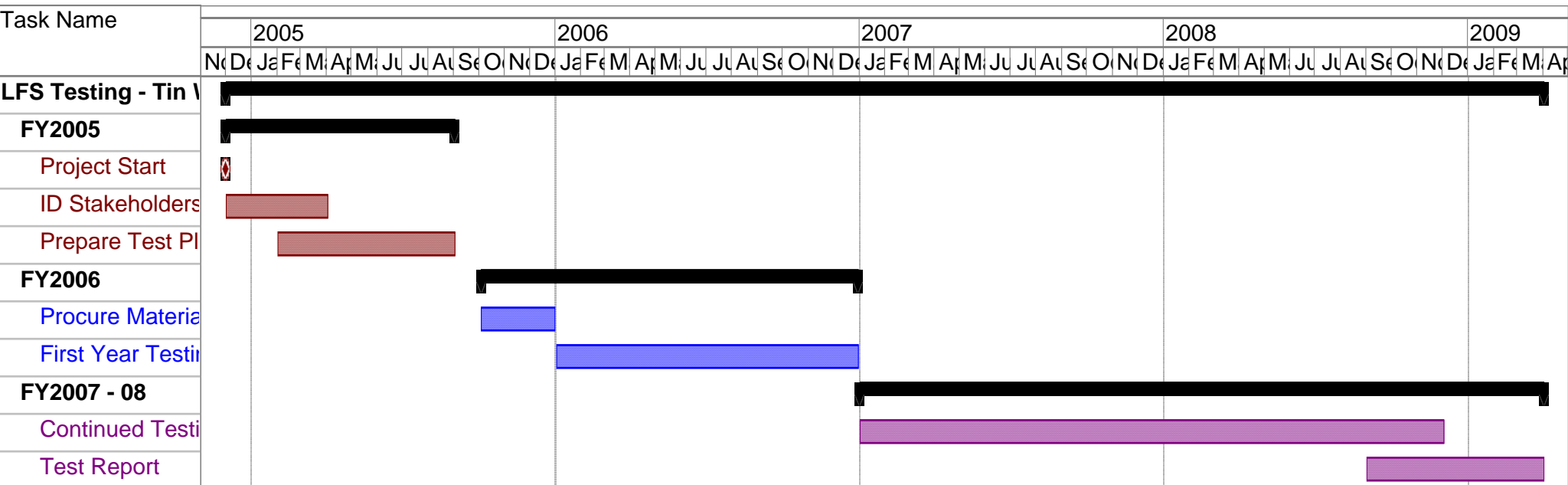
- Procure Materials: Oct – Dec 2005
- 1st Year Testing: Jan - Dec 2006

FY2007-08 (\$300K)

- Continued Testing: Jan 2007 - Dec 2008
- Test Report: Sep 2008 - Mar 2009

3. Tin Whisker Mitigation

Schedule



4. Plated-Through-Hole Reliability Testing

Issue:

Unfilled high aspect ratio plated through-holes are prone to fail on legacy military systems. What little data exists on reliability of lead-free plated-through-holes after lead-free processing is mixed. Current JCAA/JG-PP project not addressing, either.

Project Objective:

Compare electrical reliability of PTH parts after Pb & Pb-free processing and subsequent environmental testing.

Approach:

Prepare test boards containing many different PTH sizes using Pb and Pb-free processing (reflow and wave solder operations, and rework). Expose boards to environmental conditions IAW JCAA/JG-PP JTP.

Potential Stakeholders:

U.S. military services, NASA, military and commercial OEMs, FAA, gov't laboratories

4. PTH Reliability Testing

Proposed Milestones & Funding:

FY2005 (\$in-kind)

- Project Start: Dec 2004
- ID Stakeholders: Dec 2004 - Apr 2005
- Prepare Test Plan & Bill of Materials: Feb - Sep 2005

FY2006 (\$400K)

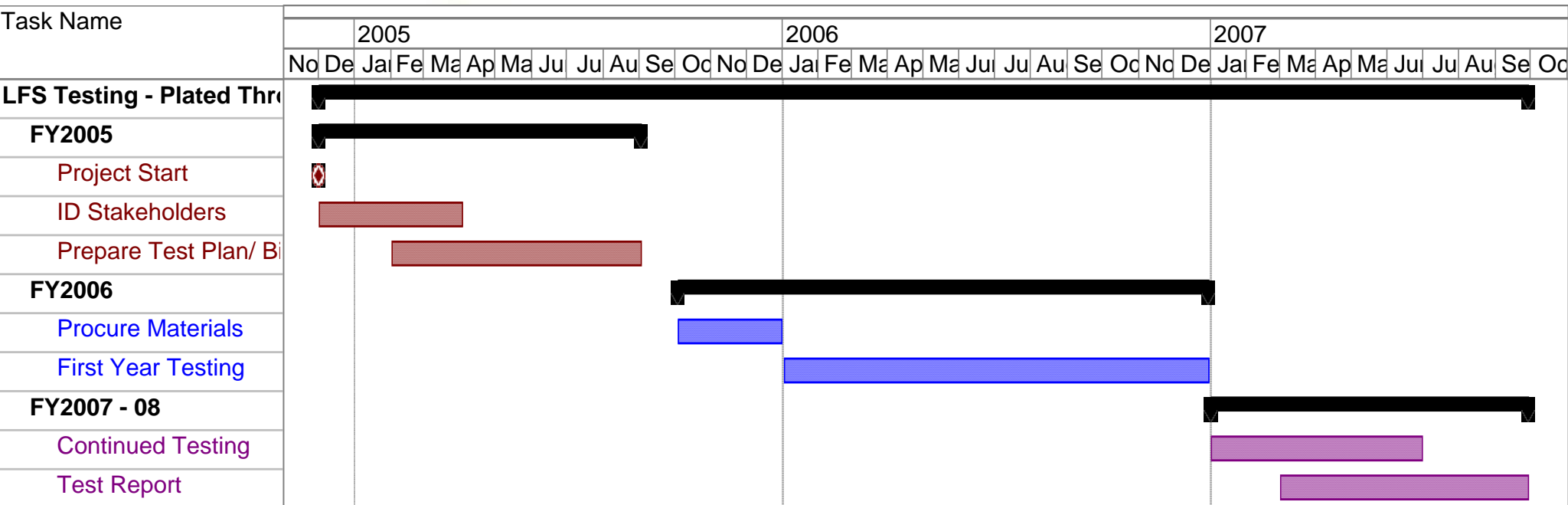
- Procure Materials: Oct – Dec 2005
- 1st Year Testing: Jan - Dec 2006

FY2007 (\$300K)

- Continued Testing: Jan 2007 - Jun 2007
- Test Report: Mar - Sep 2007

4. PTH Reliability Testing

Schedule



5. Field Test LRUs

Issue:

No known flight test data available on end-designs at Line-Replaceable Unit (LRU) level

Project Objective:

Field test the most promising lead-free solders from the proposed Project #2 (field test (radar) circuit card)

Approach:

Identify critical end-design board(s) at LRU level. Build 2 LRUs with the alternative solders. Flight test the boards for 18-months.

Potential Stakeholders:

U.S. military services, NASA, F-15 program, military and commercial OEMs, FAA, gov't laboratories

5. Field Test LRUs

Proposed Milestones & Funding:

FY2008 (\$in-kind)

- Project Start: Dec 2007
- ID Stakeholders: Dec 2007 - Apr 2008
- Prepare Test Plan & Bill of Materials: Feb - Sep. 2008

FY2009 (\$1M)

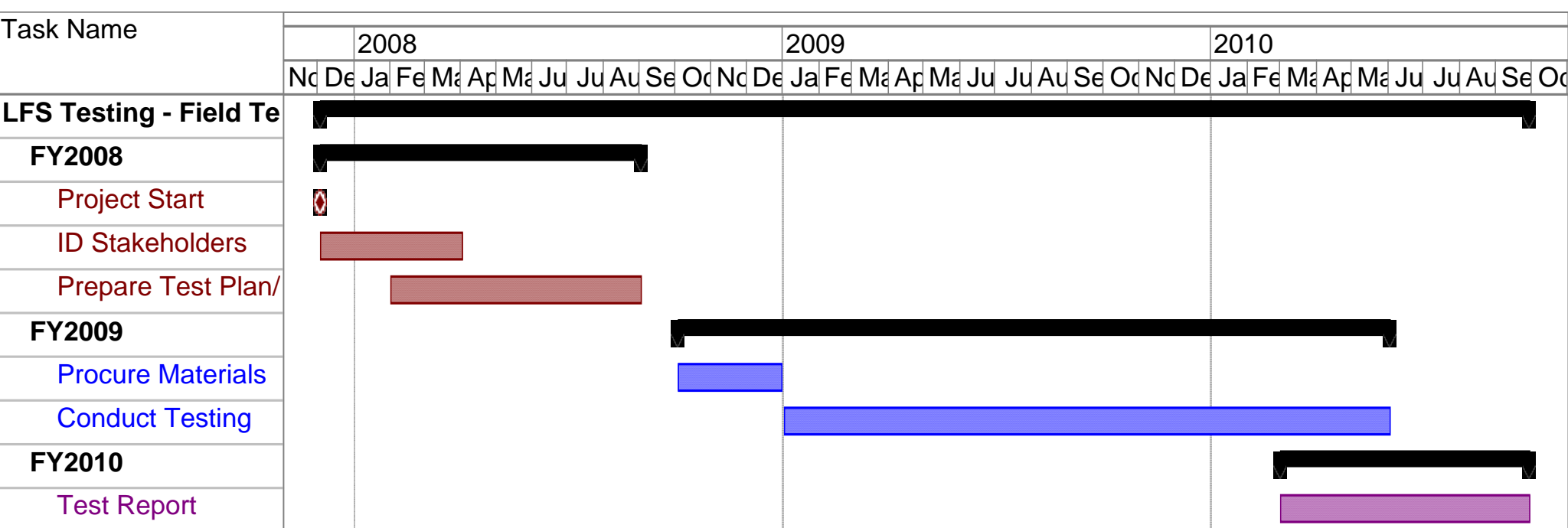
- Procure & Build Parts: Sep - Dec. 2008
- Conduct Testing: Jan 2009 - Jun. 2010 (18 months, with intermittent check-ups)

FY2010 (\$in-kind)

- Complete Test Report: Mar. - Sep. 2010

5. Field Test LRUs

Schedule



6. Dem/Val Non-Destructive Evaluation of Solder Joint and CCAs

Issue:

No way to quantitatively assess the condition of circuit card assemblies (CCAs) (either Pb or Pb-free) in critical applications in the field.

Project Objective:

Demonstrate/validate a reliable nondestructive assessment technique to quantify microstructure damage and aging effects for existing and new circuit cards in a field environment.

Approach:

Field demonstrate one or more commercial units for evaluating damage of operational circuit cards for specific DoD platform applications.

Potential Stakeholders:

U.S. military services, NASA, military and commercial OEMs, FAA, gov't laboratories

6. Dem/Val Non-Destructive Evaluation of Solder Joint and CCA Integrity

Proposed Milestones & Funding:

FY2008 (\$in-kind)

- Project Start: Dec 2007
- ID Stakeholders: Dec 2007 - Apr 2008
- Prepare Test Plan & Bill of Materials: Feb - Sep. 2008

FY2009 (\$400K)

- Procure & Build Parts: Sep - Dec. 2008
- Conduct Testing: Jan 2009 - Jun. 2010 (18 months, with intermittent check-ups)

FY2010 (\$in-kind)

- Complete Test Report: Mar. - Sep. 2010

6. Dem/Val Non-Destructive Evaluation of Solder Joint and CCA Integrity

Schedule

